



## Biophysics CAT

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### Overview

The Biophysics CAT (Bio-CAT) is organized as a national research resource to be used primarily to study the structure of partially ordered biological molecules, complexes of biomolecules, and cellular structures under conditions similar to those present in living cells. The goal of this research is to determine the detailed mechanism of action of biological systems at the molecular level. The techniques used are x-ray fiber diffraction, x-ray scattering, x-ray absorption/emission spectroscopy, and advanced imaging techniques such as diffraction enhanced imaging. The research conducted at Bio-CAT's beamlines complements that done by other APS CATs (specifically, those that emphasize protein crystallography: BioCARS, IMCA-CAT, and SBC-CAT).

### Research Focus

Many biological macromolecules (e.g., enzymes) and complexes (e.g., viruses) can be crystallized and subjected to classic crystallographic analysis. However, in living cells, most biological systems are noncrystalline, and many biological structures cannot be studied in this manner because they cannot be crystallized, are transiently formed, or have structures or dynamical behaviors that change upon crystallization. For example, comparison of x-ray absorption spectra from crystalline and solution enzyme samples has shown that the processes of crystallization can change the microstructures sufficiently that crystallographic structural analysis alone would lead to incorrect interpretations of the enzymes' mechanisms of action.

All biological systems have some degree of spatial or dynamic order; this order can be probed by noncrystallographic diffraction and x-ray absorption. Of key interest to Bio-CAT scientists are the structures of small ordered domains such as single muscle fibers and connective tissues and studies of the time dependence of structural changes that occur as biomolecular complexes carry out their functions. Key research areas involve biological processes and systems of direct biomedical importance such as enzymes (particularly metalloproteins), DNA-binding proteins, proteins involved in gene expression, cell membranes, nerve cells, immune system components, the processes of cell transport, and cell motility.

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